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AN ELECTRONIC COMMUNICATION SYSTEM FOR CLASSROOM USE WITH THE POORLY MOTIVATED STUDENT. FINAL REPORT.

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AN ELECTRONIC SYSTEM OF SMALL TRANSCEIVER UNITS, PACKAGED IN A BELT WORN BY STUDENTS IN CLASS, WAS DESIGNED TO TRANSMIT LIGHT SIGNALS AND VIBRA-TACTILE CODED MESSAGES BETWEEN STUDENTS AND A COUNSELOR AT A CLINIC SCHOOL. FOUR MALE ADOLESCENTS SELECTED FOR LOW MOTIVATION, AGGRESSIVE CLASSROOM BEHAVIOR, AND HIGH PEER-GROUP RATING REPORTED THEIR TIME SPENT ON ASSIGNMENTS, TIME SPENT IDLE, FREQUENCY OF HOSTILE STATEMENTS REGARDING ACADEMIC WORK, AND FREQUENCY OF AGGRESSIVE BEHAVIOR TOWARD OTHER STUDENTS. CONCURRENT OBSERVATION VIA ONE-WAY MIRROR CHECKED THESE REPORTS. A VARIABLE INTERVAL-VARIABLE RATIO CONTINGENT REINFORCEMENT SCHEDULE WAS USED FOR EACH TYPE OF CRITERION BEHAVIOR. FREQUENCY OF REPORTED BEHAVIOR ON ALL CRITERIA WAS ABOVE PREVIOUSLY OBSERVED NORMS, REGARDLESS OF REINFORCEMENT OR EXTINCTION, SO THE ONLY CONCLUSIONS IN THIS EXPLORATORY STUDY WERE--BELTS WERE MECHANICALLY EFFICIENT (ALTHOUGH SYSTEM RELIABILITY WAS LOW) AND WERE WELL ACCEPTED BY SUBJECTS, AND THE CODE WAS TOO COMPLEX. (LH)

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Robert Schwitzgebel

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The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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INTRODUCTION

One rather persistant problem in almost all schools is the apparent resistance or inability on the part of some students to learn and demonstrate minimum academic skills. Occasionally such students become resentful and openly hostile toward staff and fellow students. This may result not only in the individual's failure to acquire a knowledge of a particular subject matter, but also substantially hinder the teaching-learning process in the classroom.

It is generally agreed that a large proportion of such inadaptive behavior is learned. In some way, over a period of time, the student acquired or developed certain skills, attitudes, and characteristic reactions toward the classroom and academic learning situations. One possible way of conceptualizing this learning process is in terms of classical and operant conditioning. The majority of such work to date, however, has involved lower organisms or "superficial" and small segments of human motor or verbal behavior (e.g., plural pronouns, lever pressing). Also, many of the studies--often for justifiable reasons of precise experimental control--have been conducted in restricted and atypical environments. Because academic underachievement and classroom behavior disorders constitute a major education problem, and because some previous work (Schwitzgebel & Kolb, 1964) has indicated that operant procedures are applicable to adolescent behavior disorders, this project focused on academic problems of this subject population.

One of the widely-acknowledged characteristics of the acting-out underachiever is his impulsiveness. Mischel (1961), for example, using candy as a form of payment, found that juvenile delinquents generally selected a smaller immediate reward while non-delinquent students generally chose a larger delayed reward. The delayed rewards and punishments contingent on graduation, academic grades, cooperative behavior, etc., usually delivered in the classroom situation are apparently not scheduled in an appropriate manner for a substantial number of adolescent male students. As an initial hypothesis, then, one might assume that effective intervential procedures would be those which provided, initially at least, some more immediate "payoff" or feedback to the student.

Typically, counseling services in our schools are given contingent on socially inadequate behavior by the student, and the counseling interviews are scheduled 40-50 minutes on a once-a-week basis. According to the present rationale, contact by a counselor (presumably a somewhat positive experience) should be as immediately contingent as possible on improved social and/or academic behavior--particularly for impulsive youngsters. Therefore, it seems reasonable to presume that some flexible system whereby the frequency of contact could be increased but the duration of contact decreased (as a matter of economy) would be desirable.

The purpose of this research was to develop an electronic communication system capable of being used to help modify social behaviors and basic attitudes toward learning in the classroom situation among poorly motivated students. It was hypothesized that the frequency of specified classroom behaviors would be significantly altered by the immediate secondary reinforcers given through the communication system.

METHOD

The primary task was the designing, construction, and field-testing of a flexible information link between student and counselor (or, as we shall also designate the parties in the present case, between subject and experimenter). Prior to designing the system, a rather comprehensive feasibility study was undertaken. The following functional specifications were established:

a) The radio transceiver unit should be as inconspicuous on the person as feasible. This implies size and shape restrictions.

b) The transceiver should fasten to the person so that the person can have normal movement of the body and limbs, and without fear of dropping or losing the transceiver.

c) The unit should be rugged and capable of receiving physical abuse, especially for this adolescent population. Further, the unit should be physically sealed where possible to prevent and discourage the student from tampering with the components.

d) The student should have the capability of communicating only with the experimenter and not with other students.

e) The experimenter should have the capability of communicating with all of the students, but the message must be secure for the single students being addressed.

f) It is undesirable to have verbal or audio communications since in the classroom audio signals disturb others in the vicinity and call attention to the communication.

g) It is desirable to design batteries with a life of one week so that they may be replaced during the weekly office visit of the student. A one-day life battery that is rechargeable would be an acceptable alternative if arrangements were made for easy recharging during the night. It is undesirable, however, for the student to have access to remove the battery.

h) The system should be capable of having event recorders connected to it in order to automatically record and identify the time and sender of any communication.

i) The system must conform to relevant FCC regulations such as security of base stations, frequency modulation variance.

These and other similar specifications served as the basis for designing the system and generally describe the characteristics of the final functioning system.

A search of the literature on monitoring or telemetry systems (e.g., Beenken & Dunn, 1959; Cole, 1965; Geller, 1961), personal signaling systems (e.g., Bell Telephone's "Bellboy" units), and currently available radio micro-circuits indicated that in order to meet the above specifications, the major elements of the communication system would have to be designed and assembled by project staff. The major portion of project time and budget was devoted to the designing and construction of the necessary base stations and portable units.

In the latter phase of equipment development, a behavioral study was concurrently undertaken. Four students at the UCLA Psychology Clinic School were selected among volunteers to participate in the project. They were selected on the basis of age (15-17 years), academic retardation (apparently due to lack of motivation), a history of anti-social aggressive behavior in the classroom, and reasonably high peer-group rating (or above average in physical size) in order to "protect" the equipment from other curious, jealous, or hostile students.

Base-rate measures for classroom social and academic behaviors were obtained on a time-sampling basis by observers behind a one-way mirror. The recorded behavior included amount of time spent apparently working on assigned academic tasks, time spent idle, frequency of hostile statements regarding academic work, frequency of aggressive behavior toward other students. (A base-rate for positive statements regarding academic work was not obtained as such operants were virtually non-existant.)

Because the communication system was designed to transmit and receive non-audio, vibra-tactile coded messages, the subjects were given a series of five one-hour practice sessions using telegraph practice sets outside the classroom, supervised in a casual and friendly manner by the E who, prior to this time, was unknown to the subjects and who interacted with them in no other capacity (e.g., as teacher or counselor). Subsequently, the subjects were given a transceiver unit and asked to report the occurance of any of the behaviors for which a base-rate had been established. Validity of the reports was checked by concurrent observations made from the observation room.

The orthodox operant conditioning experimental design was followed in which subjects served as their own controls. Positive consequences (consisting of verbal praise and attention from the experiementer) was delivered contingently for one of the specified behaviors for a predetermined amount of time, the same consequences were then delivered noncontingently, and finally contingently again. A variable interval - variable ratio schedule of reinforcement was employed in each case.

RESULTS

A functional prototype communication system was constructed and licenced. Battery-operated radio transceiver units were packaged in leather belts, the section housing the components being 22 inches long and 5 inches in circumference (cf. Fig. 1). The subjects or the experimenter could send a coded message by depressing a small button on the front of the belt. Messages were received via a $1\frac{1}{4}$ by $1\frac{1}{4}$ by $1\frac{1}{2}$ inch vibra-tactile transducer mounted in the back of the belt and a small light in the

Fig. 1. Transceiver belt unit

top of the belt. A barely audible tone accompanied the other two signals.

A base station at the Psychology Clinic School located in the North Campus of UCLA transmitted to and received messages from the belt units worn by students in the school. A smiliar base station served the Psychology Department area in the South Campus. A rented commercial telephone line linked the quarter-mile distance between the base stations. These stations operated at an FCC assigned frequency of 165.395 Mc/s at twelve watts. Belt units operated at a frequency of 164.980 Mc/s at one watt. The experimenter's belt was designed to operate at all four frequencies, each subject's belt functioned at only one of the frequencies, thus preventing communication between the subjects.[1]

The original proposal to use Morse code was not found to be feasible due to the time and effort required to learn the code. A simple and arbitrary series of signals (e.g., two short dots for being angry at the teacher, one long dash for having spent fifteen minutes or more studying) was found to be more satisfactory. The experimenter's signals were limited to a query (e.g., "What are you doing now?"), acknowledgement of a communication, and notification of the subject that he was eligible for some type of positive consequence (e.g., time out of the class visiting with the experimenter).

The use of the belts was generally well-received by members of the class, due perhaps to the novelty and to the opportunity to spend some study periods outside the classroom to practice code. Figure 2 shows the belt as worn by one of the pilot subjects. The belts were never worn outside the school area. There is no evidence as to how such belts might be received by other students in a public school situation.

For numerous reasons, behavioral changes induced by the communication are inconclusive as to cause. A noticeable increase occurred in the frequency of self-reported behaviors on the selected dependent variables (i.e., time spent idle or working, hostile or positive expressions toward school assignments) for all subjects regardless of any attempted reinforcement or extinction. Simply requesting a subject to report a specified behavior, which then became a condition for using the belt, seemingly prompted the behavior to a level consistently above any projected base-rate.

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1. Technical information regarding system design is available from the author on request.

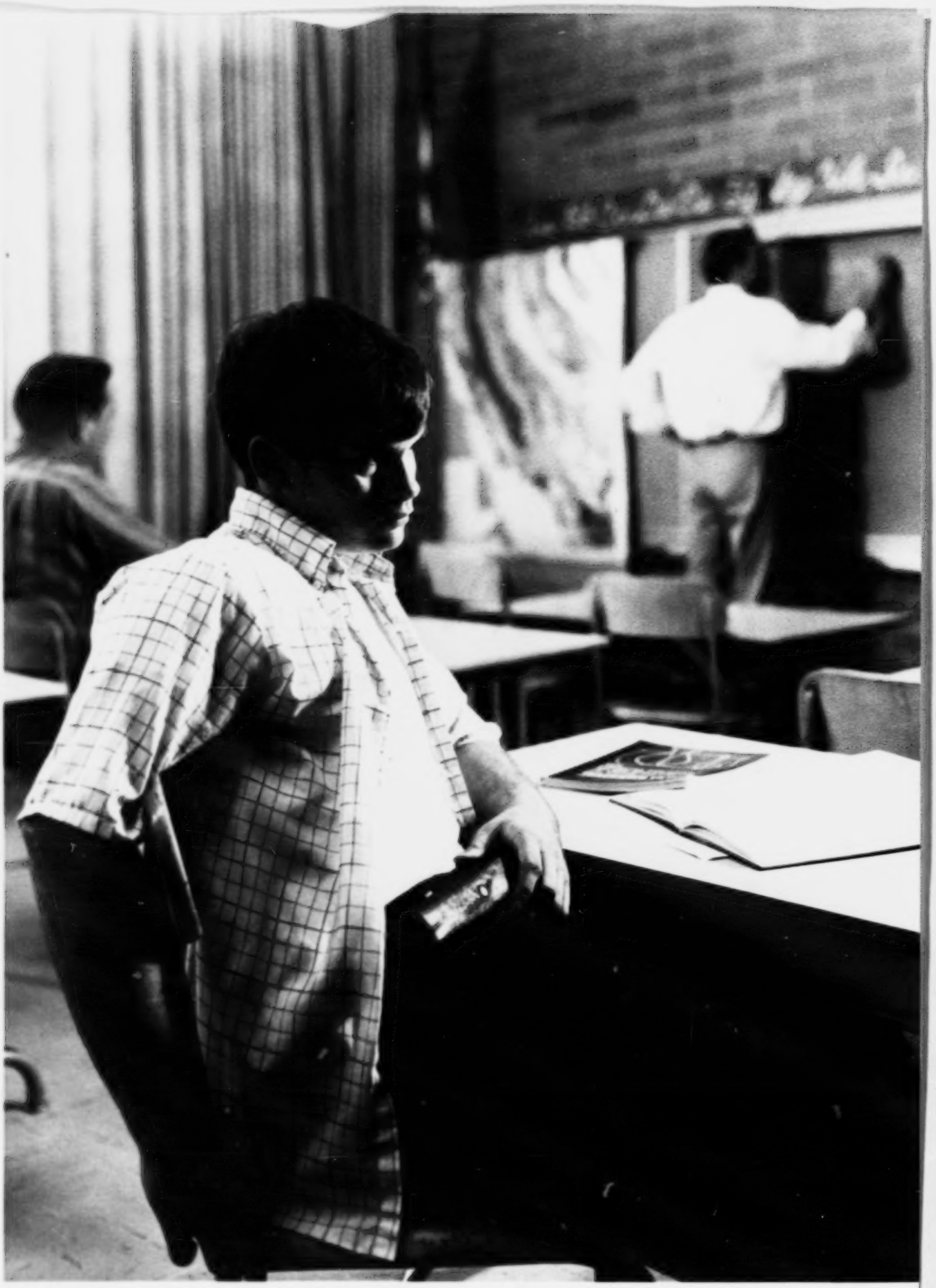

Fig. 2. Transceiver belt worn by subject in classroom

As one might have expected, subjects were particularly enthusiastic about reporting hostile feelings and statements toward the teacher.

Informal discussions among the subjects, as well as various system malfunctions, should also be noted as confounding variables. In brief, a functional transceiver system, with at least limited acceptance among adolescent underachievers, was designed and constructed. The utility of the system to modify specific classroom behaviors, however, was not demonstrated. Generally, the effect of self-reporting (with the belt serving as a discriminative stimulus for such reporting) appeared to serve as a more effective incentive than attempted contingent and noncontingent reinforcement.

DISCUSSION

The prototype radio communication system described here was shown to be physically feasible and socially acceptable with the context of a clinic school. One of the primary practical questions is, of course, the extent to which such units might be accepted in less experimentally-oriented schools. Early in the design stage, it was decided that a belt rather than a typical radio package or a harness would be the most (and perhaps the only) acceptable unit style, despite the fact that other configurations (e.g., vertical or harness antenna) are much more feasible in terms of electronic circuitry.

A second serious and socially-relevant constraint on the development of the system was the communication mode--namely, kinesthetic or vibra-tactile signalization. This was assumed to be necessary in order to assure privacy of communication in a classroom or other social situations. To the writer's knowledge, no other radio communication system has incorporated a belt package design with tactile communication.

The reliability of the total system, however, was discouragingly low. The belts did not withstand well the usual abuse given by active and curious adolescents; a $4000 budget required that some military surplus components be installed in the base stations; size limitations of the belts necessitated some belt circuits be used for both sending and receiving modes.

Fortunately, most of the difficulties encountered with respect to system reliability appear to be largely a matter of straightforward system refinement. The vibra-tactile transducer was not powerful enough to produce a very discrete signal through a layer of clothing, thus the light and tone signals became important and necessary auxiliary information channels.

The results of the present investigation are equivocal in terms of showing any differential reinforcement effects induced through the transceiver system. All self-reported behaviors which were reinforced increased but did not extinguish during nonreinforcement periods. The Hawthorne Effect plus the desire to use the belt probably account for the sustained rate. Future studies should probably be designed using several matched control subjects (e.g., belt without reinforcement, belt with reinforcement for a different behavior, no belt with reinforcement, etc.) This, however, would involve rather complex administrative arrangements, especially if some of the subject groups were to be located in different schools so that discussions among the subjects would be minimized. A base station at an approximate cost of $500 each would be required for each school. There may be a more efficient means of designing an adequate behavioral study (e.g., long-term single cases), but this is clearly a matter for future consideration. The present investigation, however, yeilded two behavioral findings which to the experimenters, at least, do not seem to be in much doubt: First, belt units can be designed and presented in such a way as to be acceptable to acting-out adolescent males; and two, the use of Morse code is impractical.

CONCLUSION AND IMPLICATIONS

In general, the basic system design was found to be mechanically satisfactory, although reliability of the operation and other contingencies necessitate the withholding of any conclusions regarding its behavior modification potential. Among the population tested, the belt units were readily accepted when introduced as an exploratory learning device.

Some further mechanical refinements are warranted prior to additional field-testing. These include adjustments in the tactile transducer, improvement of general mechanical security of the belts, and gradual reduction of overall size of the transceivers by inclusion of microminiature circuitry. One of

the most unexplored aspects of the system involves the adequacy of cutaneous signalization in an applied situation. The most extensive work on cutaneous communication to date (Geldard, 1957, 1962) has been limited to laboratory and socially impractical (e.g., wired electrodes taped to chest) conditions.

At this point, it seems likely that learning a standard code is not feasible for the majority of potential users since the effort required to learn such code is roughly comparable to touch-typing and of considerably less general practicality. A simple arbitrary code, conveying two or three bits of information, mutually decided upon by a particular student and the counselor would seem to be adequate in most cases. It is possible that a small speaker (cordless hearing aid style) could be added to the student's unit, although the acceptance of this by adolescents is questionable due to its prosthetic connotations. Our previous explorations involving verbal communication from students convinced us that this alternate arrangement is impractical. (Subjects would call taxi cabs which happened to occasionally use the same frequency, their language did not meet FCC social standards, etc.)

The present system design does not include a location-monitoring function. This should be valuable as an adjunct for gathering ecological data and for legal or therapeutic surveillance (e.g., electronic parole system for convicts. See Schwitzgebel, et. al., 1964). We believe that potential applications of such remote information links include: language analysis, medical research, its use as a "behavioral prosthetic" for retarded individuals or geriatric patients, marketing surveys, therapeutic intervention by remote control (e.g., medical assistance for cardiac patients), collection of legal evidence, and so forth. Obviously, some serious consideration should be given to the broad ethical and social issues involved in developments of this type. Well-designed research, giving special attention to parcelling out variables such as experimenter bias and the Hawthorne Effect, will have to be conducted independently at various locations before any therapeutic or instructional claims can be legitimately made for the system which has been developed and briefly described in this report.

SUMMARY

A prototype electronic communication system was designed, constructed, and field-tested for use with poorly motivated adolescent students. The system utilized small transceiver units, packaged in a belt, capable of sending and receiving vibra-tactile and light signals between the student in a classroom and a counselor at a distant location. It was hypothesized that on the basis of coded reports sent by the student, the counselor could selectively reinforce classroom behaviors such as amount of time spent studying.

The mechanical and social feasibility of the system was demonstrated among adolescent males in a clinic school, although the results of attempted reinforcement via the transceiver system were inconclusive. The students readily accepted the belt transceivers in the classroom situation. But, in addition to students' difficulties in learning standardized (Morse) code, the relatively low mechanical reliability proved to be a major limitation. System modifications and various potential applications were indicated.

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Figure 3